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TOLMAN, W. H.—History of Higher Education in Rhode Island. Bureau of Education, Cir. of Information No. 1, 1894. From the Bureau of Ed.

TRAQUAIR, R. H.—Notes on Paleozoic Fishes. Extr. Ann. Mag. Nat. Hist., 1894. From the author.

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WILLISTON, S. W.—New or Little known Extinct Vertebrates. Extr. Kansas Univ. Quart., Jan., 1895. From the author.

WRIGHT, G. F.—Replies to Criticisms. Preface to Second Ed. of Man and the Glacial Period. New York, 1894. From the author.

# General Notes.

## MINERALOGY.[1]

**New Edition of Groth's Physical Crystallography.**—The concluding part of the third edition of this classic work[2] has recently appeared, the entire book having been so largely rewritten as to be essentially new. The necessity of this shows what remarkable advances have been made in the science during the past few years. The new work is divided into three parts, treating respectively physical, geometrical, and applied crystallography. Unlike earlier editions, the development of the optics of crystals is not made to depend on Fresnel's theory of the elasticity of the ether, but the optical characters are derived by the purely geometrical methods of Fletcher. Some features of this treatment have been already referred to in these notes. This treatment of the subject, which is certainly the more logical and may prove to be easier of comprehension by the student, involves a considerable change in the nomenclature of optical directions.

The sections treating the electrical properties of crystals and the influence of mechanical forces on crystals, as would be expected, contain a vast amount of new material. In the closing section of this part,

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[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Physikalische Krystallographie und Einleitung in die krystallographische Kenntniss der wichtigeren Substanzen von P. Groth. 3d Ed. pp. 783, 3 colored plates. Engelmann, Leipzig, 1894.

Bravais's space lattice theory of molecular structure is treated comprehensively, with addition of some of the modifications which have been made to it by Sohñche, Federow and Schönflies. Professor Groth states in his preface, that "the edifice of crystal knowledge is one of the best founded in theory of any in the entire realm of physics."

The second part of the work, that treating the geometrical properties of crystals, bears but slight resemblance to the corresponding portion of the former editions. Instead of the primary classification of Naumann into six crystal systems with their partial forms, which is in general use, the differentiation of Gadolin into thirty-two classes of forms which represent all possible kinds of crystal symmetry, is adopted. This classification does away with hemihedral, hemimorphic and tetartohedral divisions, which cause so much difficulty in teaching, and is logically and scientifically superior to the classification in use. Professor Groth thinks that the simplification of the nomenclature which this classification makes possible, will make the subject easier for the student, but it seems to us that the additional conceptions of symmetry (centre of symmetry, and 1, 2, 3, 4 and 6 *zählige* axes of symmetry) which are used will more than outweigh these advantages in simplicity, except for students who have what the Germans call *raümliche Vorstellungsgabe* highly developed. Of the thirty-two classes of forms, three have now no known representative, but when it is remembered that since 1887 representatives have been discovered for six classes which before lacked examples, the probability is great that examples will soon be found of all classes. The crystal systems are retained as a sub-classification to indicate relationships, and a seventh system—the *trigonal system*—is added to include those classes which have a 3-*zählige* axis of symmetry (rhombohedral, pyramidal, trapezohedral, etc., making in all seven classes). The word cubic is adopted for the isometric system. Another important change lies in the arrangement. The class of least symmetry is considered first, and the others in the order of increasing symmetry.

The subject of the calculation and drawing of crystals, which in the former editions of the work was scattered under the different systems in the geometrical portion, is here brought together and expanded to over 60 pages in the beginning of part III. It is followed by a description of the methods of crystal measurement, in which is contained what will be to many, new descriptions of recently devised apparatus. Such is a modification by Klein and Fuess of the Federow universal attachment to the microscope stage.

The appearance of this edition of Professor Groth's work marks an epoch in the history of crystallography, and there can hardly be a doubt that all the essential features of his treatment will soon be introduced at least in all advanced courses in the science. Crystallographers will look forward with anticipation to the appearance of the great work on chemical crystallography on which Professor Groth is now engaged.

**Tables of the Thirty-two Classes of Crystal Forms.**—In 1892 Groth[3] issued a table giving the stereographic projection to indicate the most general form of each of Gadolin's classes of crystal forms, together with the position of the crystallographic axes and the axes and planes of symmetry of the class. These differ from those of his later published text-book only in that the trigonal crystal system is not introduced in the secondary classification. This table has the great advantage of bringing all the projections together on a single plate so that mutual relations may be made out. Wülfing[4] has very recently issued a series of seven plates with explanatory text which give not alone the stereographic projections to illustrate the kind of symmetry of each class, but also sketches to indicate the character of all the kinds of crystal forms which can possibly occur with that kind of symmetry. They constitute an introduction to or a synopsis of the subject of geometrical crystallography, much as it is treated by Groth, and will be of service in making the subject clear to a beginner, particularly one who cannot easily bring his mind to the condition of picturing geometrical forms. Wülfing has, however, unfortunately adhered to the old arrangement, and treats the classes of highest symmetry first; and, moreover, has not utilized the abbreviated nomenclature adopted by Groth. This and the different numeration of the classes which the old arrangement involves, will introduce confusion, and are the serious mistakes of the little book. In his preface Wülfing recalls an interesting passage in Goethe, which brings out so well the difference between the position now held by the science of crystallography and that which it occupied at the time the words were written (they were first printed in 1829) that I am inclined to introduce it here. Goethe wrote referring to the science of crystallography as follows:

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[3] Uebersichtstabelle der 32 Abtheilungen der Krystallformen mit Erlaüterungen, Beispielen, und graphischer Darstellung nach Gadolin zusammengestellt von P. Groth. Engelmann, Leipzig, 1892, 1 Mark.

[4] Tabellarische Uebersicht der einfachen Formen der 32 krystallographischen Symmetriegruppen zusammengestellt und gezeichnet von Dr. E. A. Wülfing. Koch, Stuttgart, 1895.

" Sie ist nicht productiv, sie ist nur sie selbst und hat keine Folgen...... .........Da sie eigentlich nirgends añwendbar ist, so hat sie sich in dem hohen grade in sich selbst ausgebildet. Sie giebt dem Geist eine gewisse beschräñkte Befriedigung und ist in ihren Einzelheiten so mannigfaltig, dass man sie unerschöpflich neñnen kañ, deswegen sie auch vorzügliche Meñschen so eñtschieden und lañge au sich festhält.—Etwas Mönchisch-Hagestolzenartiges hat die Krystallographie und ist daher sich selbst genug. Von praktischer Lebeñseinwirkung ist sie nicht; deññ die köstlichsten Erzeugñisse ihres Gebiets, die krystallinischen Edelsteine, müssen erst zugeschliffen werden, ehe wir unsere Frauen damit schmücken können."

Wülfing remarks "Can it not be doubtful if the sentence of Goethe's' 'crystallography has something of the bachelor monk about it and is hence sufficient unto itself; does not belong to a standpoint of the science already far behind us."

Wm. H. Hobbs.

## PETROGRAPHY.[1]

**An Example of Rock Differentiation.**—The Highwood Mountains of Montana have afforded Weed and Pirrson[2] an interesting study in rock differentiation. The mountains comprise a group of hills composed of cores of massive granular rocks surrounded by acid and basic lava flows and beds of tuff, which are cut by hundreds of dykes radiating from the cores as centers. One of these hills, isolated from the others is known as Square Butte, whose laccolitic origin can be plainly shown. The Butte is composed entirely of igneous rocks. Its center is a core of white syenite, and around this as a concentric envelope is a dark basic rock called by the authors shonkinite. Near the top of the Butte the surrounding envelope has been eroded off exposing the white rock, so that from a distance the latter appears to be capping the former. The black rock consists of biotite in large plates and augite crystals, in the irregular spaces between which are found orthoclase, olivine, a little albite and small quantities of nepheline, cancrinte and the usual accessory minerals. An analysis of the rock gave:

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Bull. Geol. Soc. Amer., Vol. 6, p 389.